

REMARKS/ARGUMENTS

Applicants acknowledge with gratitude the courtesy of Examiner Hoey in granting a personal interview with the undersigned on May 24, 2005. During the course of the interview, Claims 3, 5, 7, 9, 12-13, 15, 17 and 19-21, originally appearing in the application, were discussed, as were the newly added claims. In addition, the references cited against these originally pending claims, were also discussed. Examiner Hoey indicated that if a claim along the lines of Claim 22 were to be included in the instant Amendment, she would deem such a claim to contain allowable subject matter. The remarks set forth below summarize the arguments presented at the aforementioned interview.

Of the original claims, Claims 7, 9, 15, 17 and 19-21 remain in this application. Claims 1-6, 8, 10-14, 16 and 18 have been canceled. Claims 7, 9, 15, 17, and 19-21 have been amended to change their dependency. Claims 22 to 28 have been added. The newly added claims find support within the application. No new matter has been added.

Objection to Claim 16:

In paragraph 1 of the Office Action, claim 16 has been objected to for an error in the double usage of the verb “to be.” Claim 16 has been canceled, rendering this claim moot.

Rejection of Claims under 35 U.S.C. § 102 (b):

Claims 1, 2, 18 and 20 have been rejected in paragraph 1 of the Office Action as being anticipated by U.S. Patent No. 6,495,052 to Miyamoto et al. (hereinafter referred to as “Miyamoto”). Claims 1, 2, 3, 16, 17, 20 and 21 have been rejected in paragraph 4 of the Office Action as being anticipated by U.S. Patent No. 5,236,595 et al. (hereinafter referred to as “Wang”). Claims 1 and 2 have been rejected in paragraph 5 of the Office Action as being anticipated by U.S. Patent No. 6,267,895 to Engelhard et al. (hereinafter referred to as “Engelhard”). Claims 1, 2, 16 and 20 have been rejected in paragraph 6 of the Office Action as being anticipated by U.S. Patent No. 6,156,210 to Sadkhin (hereinafter referred to as “Sadkhin”).

Cancellation of Claims 1-6, 8, 10-14, 16 and 18 renders these rejections moot.

Rejection of Claims under 35 U.S.C. § 103 (a):

Claim 4 has been rejected in paragraph 8 of the Office action as being obvious over Miyamoto or Sadkhin, as applied to the rejection of claim 2 (under 35 U.S.C. § 102), and further in view of U.S. Patent No. 6,555,803 to Bolton et al. (hereinafter referred to as “Bolton”). Claims 4 and 5 have been rejected in paragraph 9 of the Office action as being obvious over Wang, as applied to the rejection of claims 2 and 3 (under 35 U.S.C. § 102), and further in view of U.S. Patent No. 6,555,803 to Bolton. Claims 6, 8, 10 and 11 have been rejected in paragraph 10 of the Office action as being obvious over Miyamoto or Sadkhin, as applied to the rejection of claim 2 (under 35 U.S.C. § 102), and further in view of U.S. Patent No. 6,602,425 to Gadgil et al. (hereinafter referred to as “Gadgil”). Claims 6-13 have been rejected in paragraph 11 of the Office action as being obvious over Wang, as applied to the rejection of claims 2 and 3 (under 35 U.S.C. § 102), and further in view of Gadgil. Claims 14 and 15 have been rejected in paragraph 12 of the Office action as being obvious over Wang, as applied to the rejection of claims 2 and 3 (under 35 U.S.C. § 102), and further in view of U.S. Patent No. 5,342,528 to Adachi et al. (hereinafter referred to as “Adachi”). Claims 18 and 19 have been rejected in paragraph 13 of the Office action as being obvious over Wang, as applied to the rejection of claims 2 and 3 (under 35 U.S.C. § 102), and further in view of Miyamoto.

Cancellation of Claims 1-6, 8, 10-14, 16 and 18 renders the rejections in paragraphs 8 and 10 of the Office Action moot. As to the relevant portions of the rejections appearing in paragraphs 9 and 11 to 13, the following remarks are pertinent.

The invention recited in Claim 22 is directed to a process for disinfecting water that may contain viruses by introducing silver ions to the water followed by irradiation of the water using a fluence of about 1 mJ/cm² to about 200 mJ/cm². As noted in the subject specification, silver alone is generally inadequate to disinfect water except under certain conditions because of the long contact times necessary and because of silver-resistant organisms. In contrast to using silver as a sole agent for disinfecting water, ultraviolet (UV) radiation is considered a viable process for disinfecting drinking water and

wastewater in large-scale water treatment systems because it is an effective means of inactivating pathogens, including bacteria, viruses and protozoa. However, while some methods of disinfecting water using UV light are capable of achieving high degrees of disinfection for many pathogens, they are less successful at achieving inactivation of other pathogens, such as viruses generally and adenoviruses in particular, which have been reported to be emerging as the pathogens most resistant to UV disinfection. In addition, even where these methods are able to achieve their goals, it comes at the expense of high capital and operating costs associated with the generation of the UV radiation necessary to achieve substantial and acceptable disinfection levels.

As shown in Figure 1 and on page 10 of the subject specification, the combination of introducing silver ions to water to be disinfected and UV irradiation, particularly when the irradiation is conducted after the introduction of silver ions, produces a synergistic disinfection or inactivation effect. Thus, bar 3 of Figure 1 shows the arithmetic sum of bars 1 (only silver treatment) and 2 (only UV treatment) for inactivation rates of water containing MS-2 virus. When bars 4 (reflecting treatment with silver at a concentration of 0.1 mg/L for 10 minutes, followed by UV radiation (*ca.* 40 mJ/cm²) then neutralized to terminate silver disinfection immediately (10 min total silver exposure)) and 5 (reflecting treatment with silver at a concentration of 0.1 mg/L for 10 minutes, followed by UV radiation (*ca.* 40 mJ/cm²) then neutralized 120 min after exposure to UV (130 min total silver exposure)) with bar 3, it can be clearly seen that a synergistic effect is clearly produced by addition of silver ion followed by UV irradiation.

None of the references cited against the claims describe the method of treating virus-containing water with silver ions and ultraviolet light, in that order, using a fluence of about 1 mJ/cm² to about 200 mJ/cm², to achieve the synergistic effect described above and in the subject specification. None of the references suggest that this reduction of fluence may be achieved by the method in treating water in which the concentration of silver ions is that specified in claims 23, 24 and 25. Likewise, none of the references suggest that this reduction of fluence may be achieved by the method of the invention, which treats water containing any or all of the pathogens recited in claim 28.

Wang is cited against the claims as teaching a method for removing contaminants from liquid in a disinfection procedure by a UV pretreatment, subsequently passing the liquid through a silver impregnated GAC filter, and then passing the liquid through a UV post-treatment means. The Office Action cites Bolton in combination with Wang in paragraph 9 to reject claims 4 and 5, noting that Bolton discloses a method for inactivating *Cryptosporidium* and similar organisms using UV radiation in doses from about 1 to 175 mJ/cm². Gadgil is cited in paragraph 11 of the Office Action in combination with Wang to reject claims 6-13. The Office Action asserts that the claims differ from Miyamoto (*sic*) by reciting a specific wavelength of UV light but that Gadgil discloses the use of low and medium pressure mercury lamps and a wavelength of 254 nm in a method for disinfecting water. Adachi is cited in paragraph 12 of the Office Action in combination with Wang to reject claims 14 and 15. The Office Action points out that while the claims differ from Wang by reciting that the silver ions are present as silver nitrate, Adachi describes a water purification process in which water is passed through activated carbon impregnated with silver ions and that silver nitrate may be used to impregnate the carbon. The Office Action cites Miyamoto in combination with Wang in paragraph 13 to reject claims 18 and 19, noting that Miyamoto describes the step of removing silver ions from treated drinking water, as do claims 18 and 19.

Applicants submit that the rejection of the currently pending claims is not proper. Wang describes an elaborate and multi-step process using a complicated apparatus to treat water. The process uses various types of filtration including both reactive and/or non-reactive filters and allows for the use of UV radiation as a pretreatment and/or a post treatment. The process also allows for the use of other treatment steps including ozonation, chlorination, chemical treatment, compressed air aeration, air emission control, etc. There is, however, no explicit suggestion to introduce silver ions to water followed by UV irradiation of the water to disinfect the water, nor is there any suggestion of a particular fluence to be used to inactivate a variety of pathogens. The number of possible combinations and permutations of steps that can be used with Wang's invention is very large. To arrive at the claimed invention, even for the sake of argument disregarding the

required fluence (and Applicants are not saying that the required fluence should be disregarded), would require someone to wade through a vast number of different steps and procedures and to decide which steps to retain and which should be eliminated. It would then be necessary to decide the order of those steps. It would be necessary to also turn a blind eye to some of the teachings of Wang to filter the water which would have the undesirable effect of removing silver prior to UV irradiation. All of this would have to be done with scant guidance from Wang since Wang is not concerned with the elimination of all pathogens, particularly viruses, nor with the concomitant savings of energy.

The other patents cited against the claims do not complement the shortcomings of Wang's teachings to render the claims obvious. For example, with regard to the rejection of claims 4 and 5, Bolton uses UV irradiation alone to treat water to inactivate *Cryptosporidium parvum* and *Giardia muris*. There is no suggestion by Bolton to use silver ions prior to UV irradiation nor even to use silver ions at all, and due to the shortcomings of Wang noted above, this problem is not resolved. Although Bolton is able to inactivate water samples containing protozoans, such as *Cryptosporidium parvum* and *Giardia muris*, as noted in the literature and in the subject application (pages 4 and 15) inactivation of a full range of pathogens (claim 26), and particularly viruses (claim 27) requires higher fluences and, therefore, energy. While Bolton is able to inactivate protozoans with the specified range of fluences using only UV radiation, there is no indication either that other pathogens, such as viruses, could be inactivated using that range of fluences or that the introduction of silver prior to irradiation would produce a synergistic effect, allowing lower fluences to be used to achieve inactivation. Reconsideration of this rejection is respectfully requested.

In response to the rejection of claims 6-13 over Wang and Gadgil, Wang has already been addressed and the comments set forth above are incorporated herein as appropriate to this situation. Like Bolton, Gadgil uses only UV irradiation and appears to be silent about the use of silver. The UV light is produced by low, medium and high pressure mercury lamps that emit radiation in the range of 220 to 300 nm. The only discussion in Gadgil of the type of pathogens that may be treated or removed by the

process relates to the use of a candle filter that removes, *inter alia*, “large bacteria, some large protozoan cysts.” In the Gadgil patent, there is no indication what pathogens, such as viruses, could be inactivated, what range of fluences could be used or that the introduction of silver prior to irradiation would produce a synergistic effect, allowing lower fluences to be used to achieve inactivation. Reconsideration of this rejection is respectfully requested.

In response to the rejection of claims 14 and 15 over Wang and Adachi, Wang has already been addressed and the comments set forth above are incorporated herein as appropriate to this situation. Adachi discloses a water disinfection process in which water is passed through activated carbon that is used to support silver and/or an inorganic silver compound and a water soluble alkaline earth metal salt. Adachi also appears to be silent as to what pathogens, such as viruses, could be inactivated, what range of fluences could be used or that the irradiation of the water subsequent to the introduction of silver to the water would produce a synergistic effect, allowing lower fluences to be used to achieve inactivation. Reconsideration of this rejection is respectfully requested.

In response to the rejection of claims 18 and 19 over Wang and Miyamoto, Wang has already been addressed and the comments set forth above are incorporated herein as appropriate to this situation. Miyamoto describes a method of disinfecting water in which the water is initially filtered, optionally passed through a secondary filtering stage that includes a UV light or ozone treatment, exposed to a bactericide which may be metal ions, such as silver ions, and the metal ions are then removed. Even were one to combine the teachings of Wang and Miyamoto, the claimed invention would not result. As noted above, most, if not all of the procedures of Wang use filtration methods which would have the effect of removing silver prior to UV irradiation. Thus, even if Miyamoto, which describes a process that optionally uses UV irradiation followed by introduction of a bactericide such as silver were to be used, the silver would have already have been removed by Wang’s process. Furthermore, Miyamoto is silent as to what range of fluences could be used or that the irradiation of the water subsequent to the introduction of silver to the water would produce a synergistic effect, allowing lower fluences to be used to achieve inactivation. Reconsideration of this rejection is respectfully requested.

In view of the above changes and arguments, Applicants submit that none of the references cited against the claims teach or suggest the claimed invention. Reconsideration of the rejections and allowance of the claims is respectfully requested. Should there remain any issues outstanding, the Examiner is invited to call the undersigned at his office telephone number set forth below.

Respectfully submitted,

By Herbert C. Rose 15 June 2005

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